RSK ADAS

Preston Farm Solar PV Development

Flood Risk Assessment & Outline Surface Water Drainage Strategy

882216-R1(00)-FRA

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RSK GENERAL NOTES

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Author	C Whittingham	**Technical reviewer**	K Jackson
Signature		Signature	
Date:	March 2021	Date:	March 2021
Project manager	C Whittingham	**Project Director**	K Dillon
Signature		Signature	
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CONTENTS

APPENDICES

1 INTRODUCTION

1.1 Context

RSK Land and Development Engineering Ltd (RSK) was commissioned to carry out a Flood Risk Assessment (FRA) for RSK ADAS (the 'client'). The assessment is in support of the detailed planning submission for the proposed solar farm at the land off Preston Farm Solar PV Development (the 'site').

The assessment has been prepared in accordance with the National Planning Policy Framework (NPPF)[1] and its accompanying Planning Practice Guidance[2], the Interim Code of Practice for Sustainable Drainage[3], BS 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice[4], BS 8582:2013 Code of practice for surface water management for development sites[5] and the Non-statutory technical standards for sustainable drainage systems[6], with site-specific advice from the Environment Agency (EA), the Lead Local Flood Authority (LLFA), the Local Planning Authority (LPA), the architect and the client.

The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

The key definitions within the PPG are:

- "Flood risk" is a combination of the probability and the potential consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources; and,
- "Areas at risk of flooding" means areas at risk from all sources of flooding. For fluvial (river) and sea flooding, this is principally land within Flood Zones 2 and 3. It can also include an area within Flood Zone 1 which the EA has notified the local planning authority as having critical drainage problems.

For this site, the key aspects that require the assessment are:

- The EA's indicative flood zone map shows that large sections of the site are located within an area of Flood Zone 1 (shown in Figure 1.1 and 1.2); and,
- The site area is in excess of 1Ha therefore surface water drainage must be considered, and sustainable drainage systems (SuDS) incorporated, where possible.

[1] Communities and Local Government, 'National Planning Policy Framework', February 2019.

[2] Communities and Local Government, 'Planning Practice Guidance - Flood Risk and Coastal Change, ID 7', March 2014. http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

[3] DEFRA, 'Interim Code of Practice for Sustainable Drainage Systems' National SUDS Working Group, July 2004.

[4] BSI, 'BS 8533-2011 Assessing and managing flood risk in development Code of practice', October 2011.

[5] BSI, 'BS 8582:2013 Code of practice for surface water management for development sites', November 2013.

[6] DEFRA, 'Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems', March 2015.

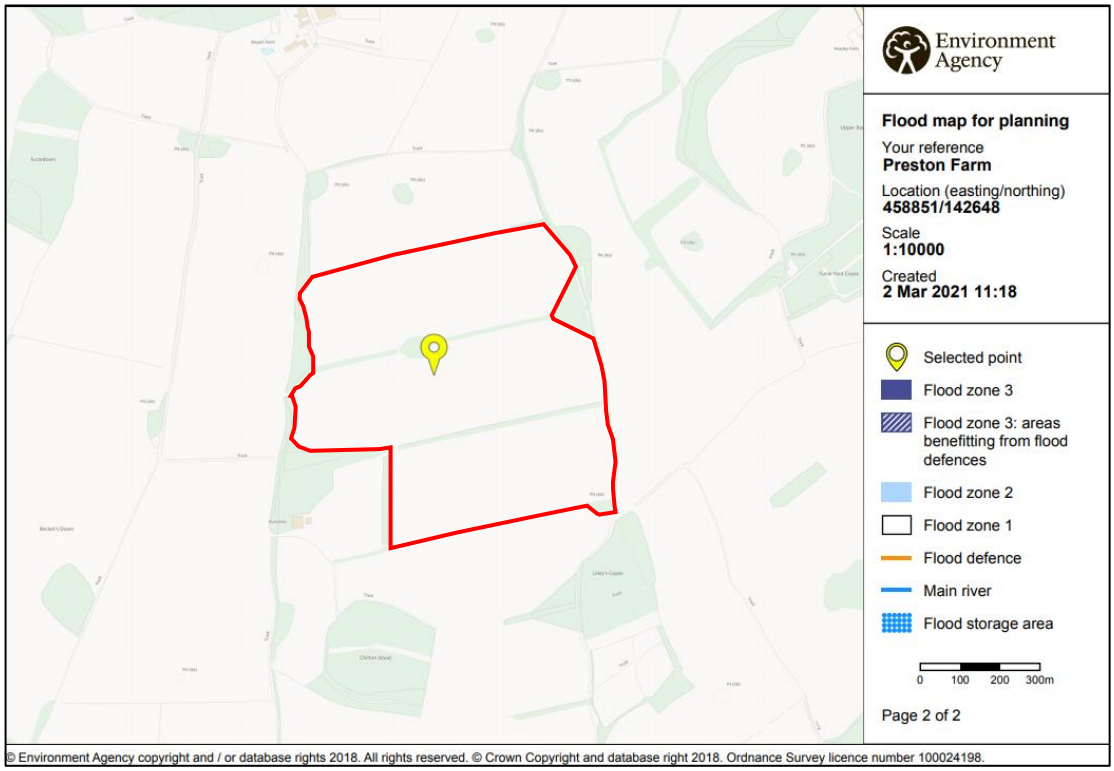


Figure 1. 1: Environment Agency 'Flood map for Planning' – Main PV Site

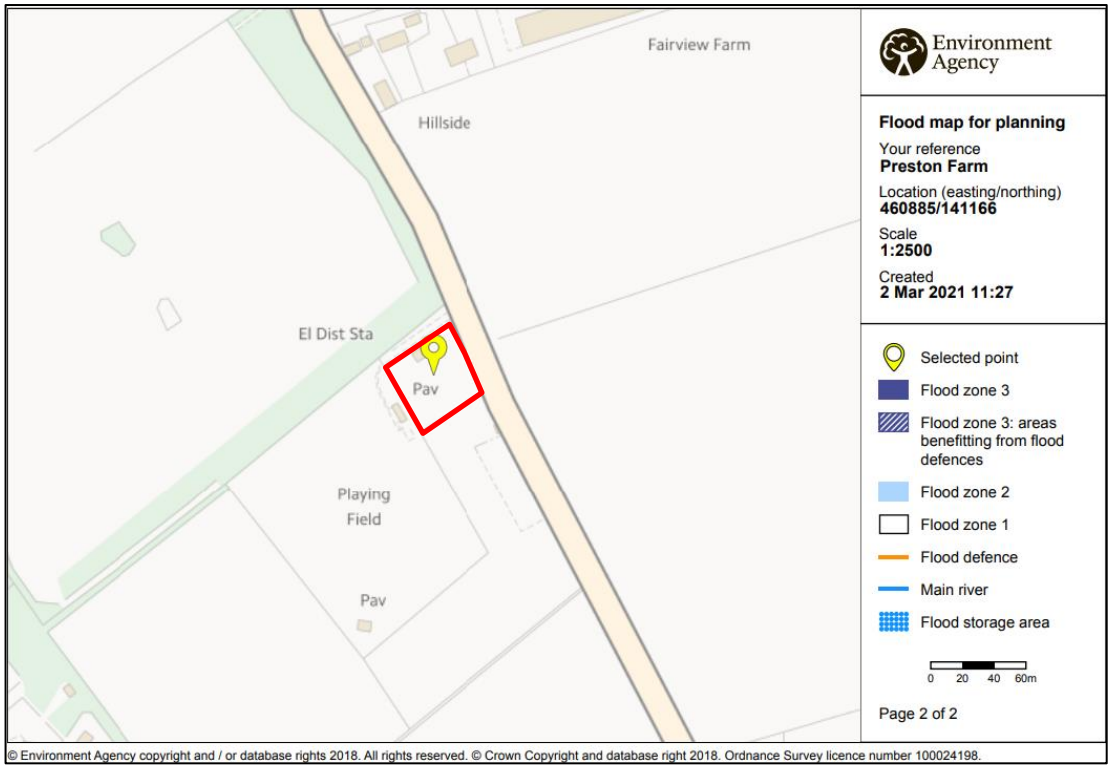


Figure 1.2: Environment Agency 'Flood map for Planning' – POC location

1.2 Scope of work

A key element of project development is to prepare a FRA to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The scope of work relating to a FRA is based on the guidance provided in Section 14 of the NPPF and its accompanying Planning Practice Guidance.

A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review architect plans, planning information and other studies to determine existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the EA/LLFA including scope, location and impacts;
- To determine the extent of new flooding provision and the influence on the site;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 35-year period for energy production uses;
- To review site surface water drainage based on the proposed layout and, if necessary, to determine the extent of infrastructure required; and
- To prepare a report including calculations and summaries of the source information and elements reviewed.

Reliance has been placed on factual and anecdotal data obtained from the sources identified. RSK cannot be held responsible for the scope of work, or any omissions, misrepresentation, errors or inaccuracies with the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

The comments given in this report and opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 SITE DESCRIPTION

2.1 Existing site

2.1.1 Location

Site Name and Address: Preston Farm Solar PV Development, Off B3046, Preston Candover, Basingstoke.

Site National Grid Reference: (E) 458901; (N) 142618

The site is approximately 46.6Ha in size and is located to the south of Basingstoke. Currently, the site consists of arable fields. Access to the site is currently proposed to be from the existing access track from the B3046.

A site location and layout plan is provided in **Figure 2.1**

Figure 2.1: Site Location

2.1.2 Topography

A site-specific topographic survey has not been undertaken for the site and ground level data has been taken from other mapping sources. Figure 2.2 below illustrates the localised topography. A site specific topographic survey has been carried out and is included as **Appendix B**.

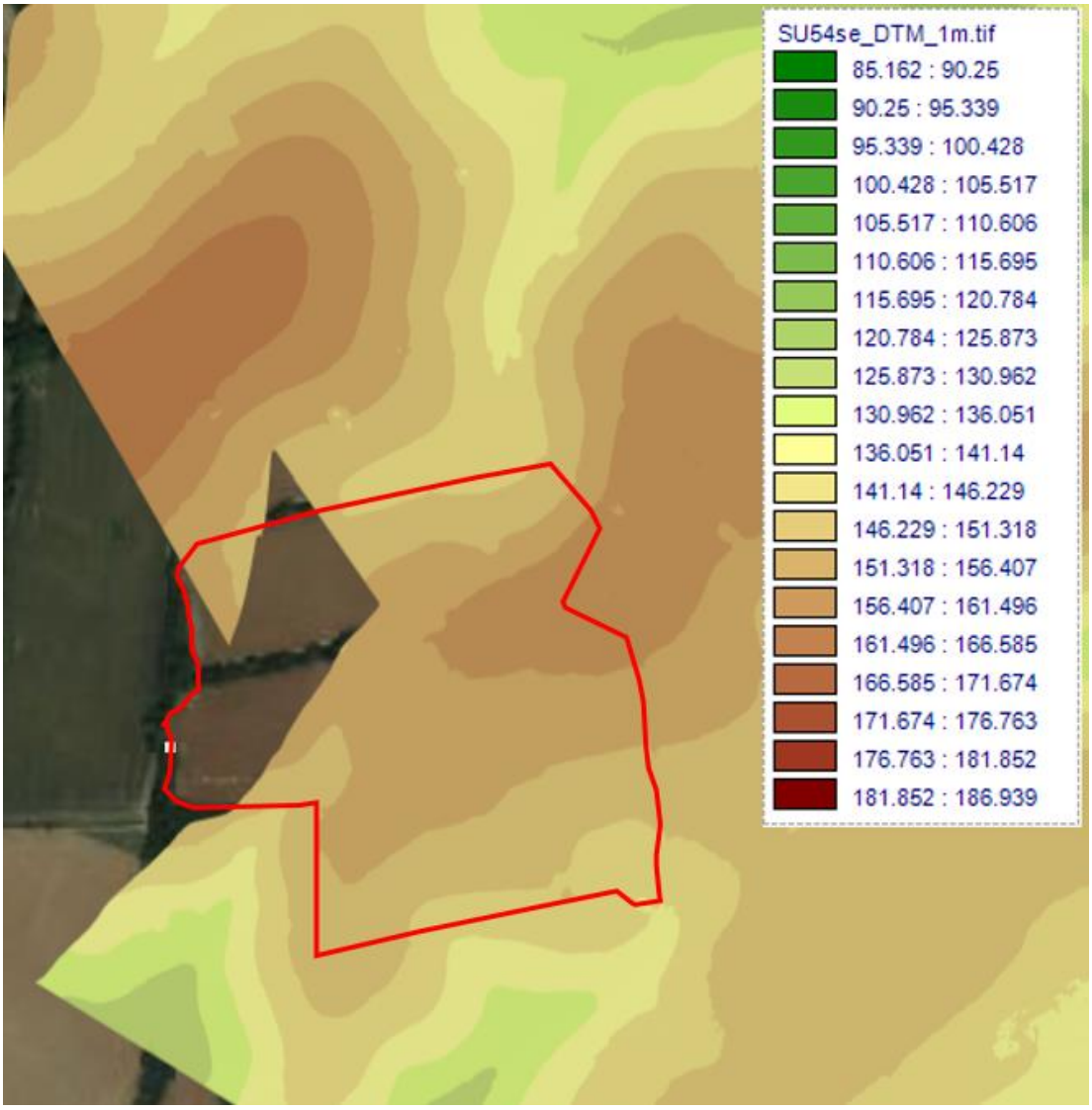


Figure 2.2: Surrounding topography

2.1.3 Hydrology

There are no mapped watercourses within or surrounding the site boundary of either the main PV site, or the POC site.

There is a small ponded area associated with Breach Farm to the north, this is likely to be an ornamental feature accompanying with the farmhouse.

2.1.4 Geology

According to British Geological Surveying mapping, the underlying geology on the site can be described as the following:

- Superficial Geology: Bands of clay-with-flints Formation - Clay, Silt, Sand And Gravel. Superficial Deposits formed up to 23 million years ago in the Quaternary and Neogene Periods. Local environment previously dominated by weathering processes
- Bedrock Geology: Newhaven Chalk Formation - Chalk. Sedimentary Bedrock formed approximately 72 to 86 million years ago in the Cretaceous Period. Local environment previously dominated by warm chalk seas.

BGS Borehole data records were searched for nearby borehole logs that may give relevant information regarding the on-site geology. Only one relevant log has been recorded, this confirms the site to be underlain by chalk and groundwater is at a significant depth.

2.1.5 Hydrogeology

Hydrogeological information was obtained from the online Magic Maps service. Mapping shows the site is not underlain with any designated superficial aquifers.

Groundwater Source Protection Zone mapping identifies that as section of the main PV site is located in a SPZ Zone 3. Zone 3: (Total catchment) - This zone is defined as the total area needed to support the abstraction or discharge from the protected groundwater source.

Figure 2.3: Location of SPZ Zone 3

2.2 Development proposals

The proposal is for the erection of a solar photovoltaic (PV) array with a total installed capacity of 28 MWp (**Appendix B**).

3 LEGISLATION, POLICY AND GUIDANCE

3.1 National policy

Table 3.1: National legislation and policy context

Legislation	Key provisions
National Planning Policy Framework (2019)	The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.
Planning Practice Guidance (2014)	The NPPF is supported by an online Planning Practice Guidance, which provide additional guidance on flood risk.
Flood and Water Management Act 2010[7]	The Flood and Water Management Act (FWMA) aims to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues. There are a number of increased responsibilities within the Act that affect adoption of SuDS features and the role of the EA to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.
Water Resources Act 1991[8]	Section 24 – The EA is empowered under this Act to maintain and improve the quality of 'controlled' waters Section 85 – It is an offence to cause or knowingly permit pollution of controlled waters Section 88 – Discharge consents are required for discharges to controlled waters
Water Framework Directive (2000)[9]	The Water Framework Directive (WFD) requires all inland and coastal waters to reach 'good' chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters. The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.

[7] Flood and Water Management Act, 2010

[8] Water Resources Act, 1991

[9] EU Water Framework Directive, 2000

3.2 Local policy

Table 3.2: Local policy legislation and policy context

Document	Key provisions
Basingstoke and Deane Local Plan (2011 to 2029) Adopted May 2016	Policy EM7 – Managing Flood Risk The sequential approach to development, as set out in national guidance, will be applied across the borough, taking into account all other sources of flooding as contained within the council's Strategic Flood Risk Assessment (SFRA). Development within areas of flood risk from any source of flooding24, will only be acceptable if it is clearly demonstrated that it is appropriate at that location, and that there are no suitable available alternative sites at a lower flood risk. Development proposed in an area at risk of flooding will be required: a) To be supported by a Flood Risk Assessment25 (FRA) (subject to the triggers set out below); b) To clearly demonstrate that the benefits of the development to the community, outweigh the risk of flooding when applying the sequential test and exception test (where required); c) When applying the sequential test, to clearly demonstrate that the impacts of climate change are taken into account as identified in the SFRA; d) To provide a safe access and egress route up to a 1 in 100 year event plus climate change; and e) To attenuate surface water run-off so that the run-off rate is no greater than the run-off prior to development taking place or, if the site is previously developed, development actively reduces run-off rates and volumes.

3.3 Area guidance

Table 3.3: Area Guidance

Legislation	Key provisions
Basingstoke and Deane Borough Council Strategic Flood Risk Assessment for Local Development Framework Final January 2010	The principle aim of a Strategic Flood Risk Assessment (SFRA) is to map all forms of local flood risk in order to provide an evidence base to locate new development. It also aims to provide appropriate policies for the management of flood risk and identify the level of detail required for site-specific FRAs. The SFRA contains information and maps detailing flood sources and risks. The site nor the surrounding areas are referred to within the SFRA.
Hampshire County Council Preliminary Flood Risk Assessment April 2011	A Preliminary Flood Risk Assessment (PFRA) is the first part of the planning cycle for flood risk management as set out in the Flood Risk Regulations (2009), which implement the requirements of the EU Floods Directive (2007). The EU Floods Directive aims to provide a consistent approach to managing flooding across Europe. The LLFA is responsible for producing the PFRA. The PFRA considers local sources of flooding that the LLFA is responsible for: ordinary watercourses, surface water, groundwater and sewers where flooding is wholly or partially caused by rainwater or other precipitation entering or affecting the system. Information is gathered from existing sources on past floods and flood models to identify Flood Risk Areas.

4 SOURCES OF FLOOD RISK

4.1 Criteria

In accordance with the NPPF[1] and advice from the EA, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 35 years).

Changes to climate change guidance in February 2016 indicate that increased allowances in peak river flow and rainfall intensity should now be incorporated within any assessment. The appropriate allowance for peak river flow is based on the site's location in the country, the lifetime of development, the relevant flood zone and the vulnerability of the proposed end use.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- Flooding from rivers (fluvial flood risk);
- Flooding from the sea (tidal flood risk);
- Flooding from the land;
- Flooding from groundwater;
- Flooding from sewers (sewer and drain exceedance, pumping station failure etc); and
- Flooding from reservoirs, canals and other artificial structures.

The following section reviews each of these in respect of the subject site.

4.2 Flooding from rivers and the sea (fluvial and tidal flood risk)

4.2.1 Main river

The EA Flood Zone mapping study for England and Wales is available on their website at: https://flood-map-for-planning.service.gov.uk.

The latest Environment Agency published flood zone map (**Figure 4.1** and **Figure 4.2**), taking into account the presence of flood defences, shows the site to be wholly located in defended Flood Zone 1 (representing a less than a 1 in 1000 or greater annual probability of river flooding).

The resultant fluvial flood risk to the developable area is considered to be **very low**.

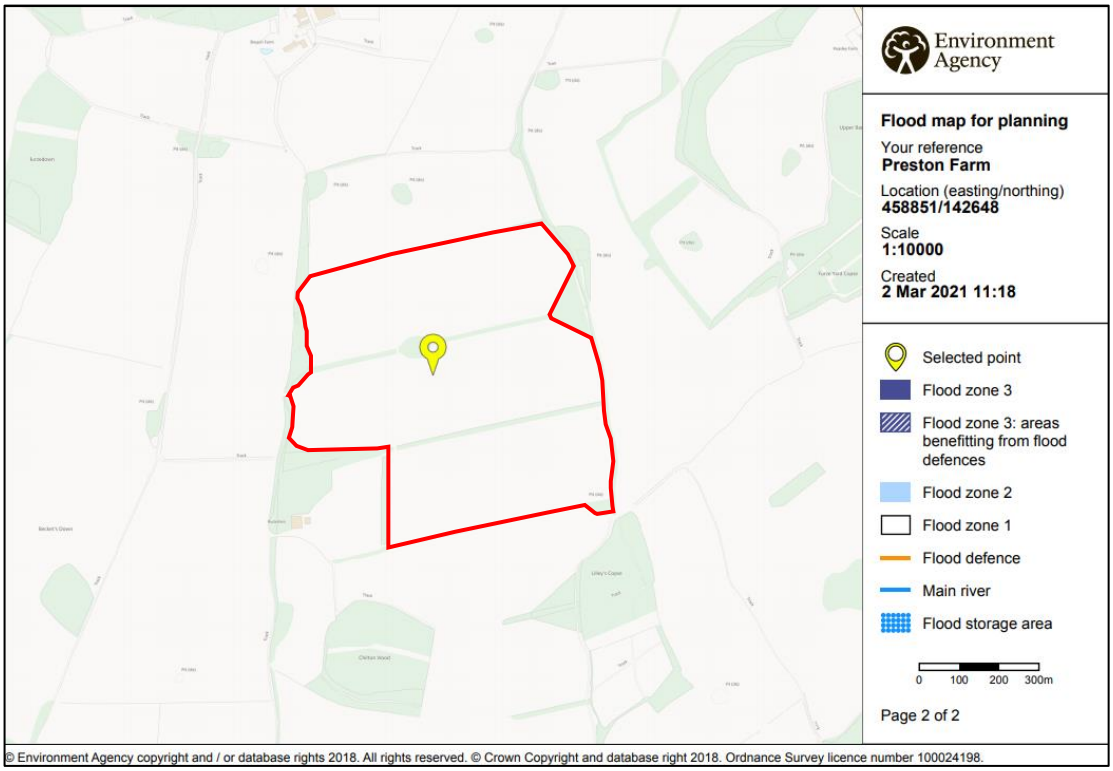


Figure 4.1: Environment Agency 'Flood map for Planning' – Main PV Site

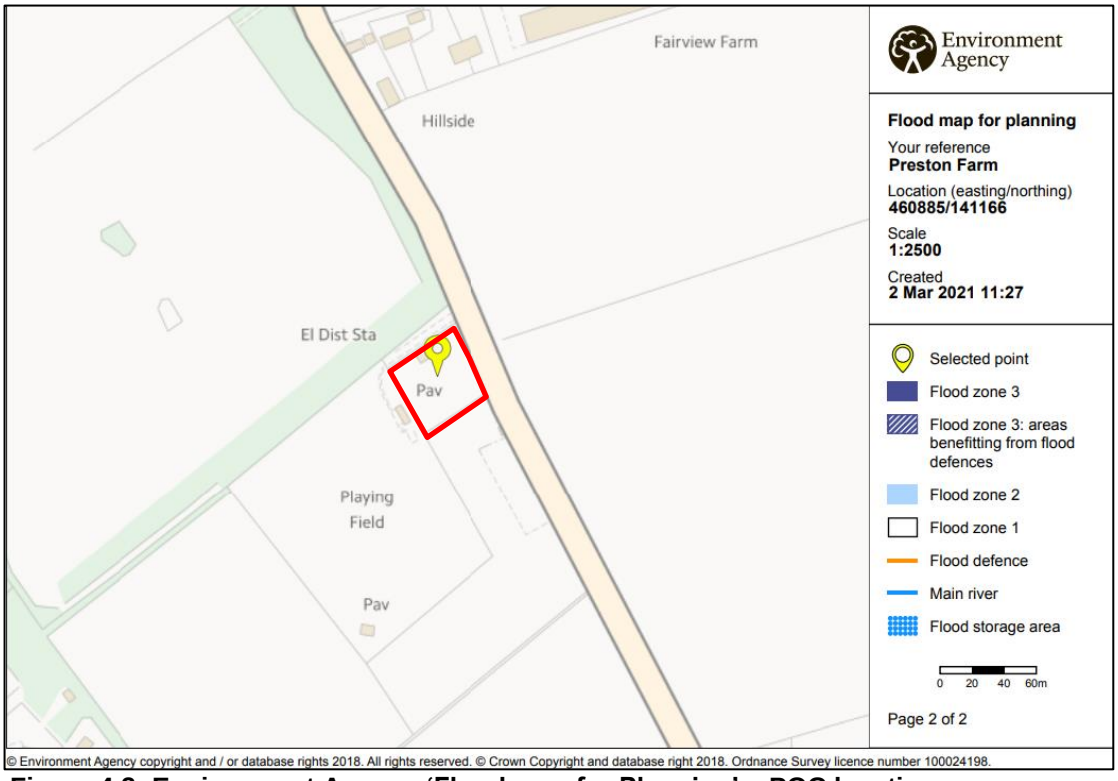


Figure 4.2: Environment Agency 'Flood map for Planning' – POC location

4.2.2 Climate change

Fluvial and tidal flooding is likely to increase as a result of climate change. A greater intensity and frequency of precipitation is likely to raise river levels and increase the likelihood of a river overtopping its banks. Climate change guidance for river modelling was updated by the EA in February 2016. No model re-runs have been undertaken as part of this site-specific FRA due to the distance from the site to the nearest area of fluvial flood risk.

4.3 Flooding from the land (overland pluvial flood risk)

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse. Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff can occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

The EA's surface water flood map (**Figure 4.3** and **Figure 4.4**) shows pluvial flood risk to the site. On the Main PV site there is one minor flow path to the north. This is a 'very low' risk flow path. The proposed development will not restrict this flow path and will therefore not exacerbate the issue on or off site.

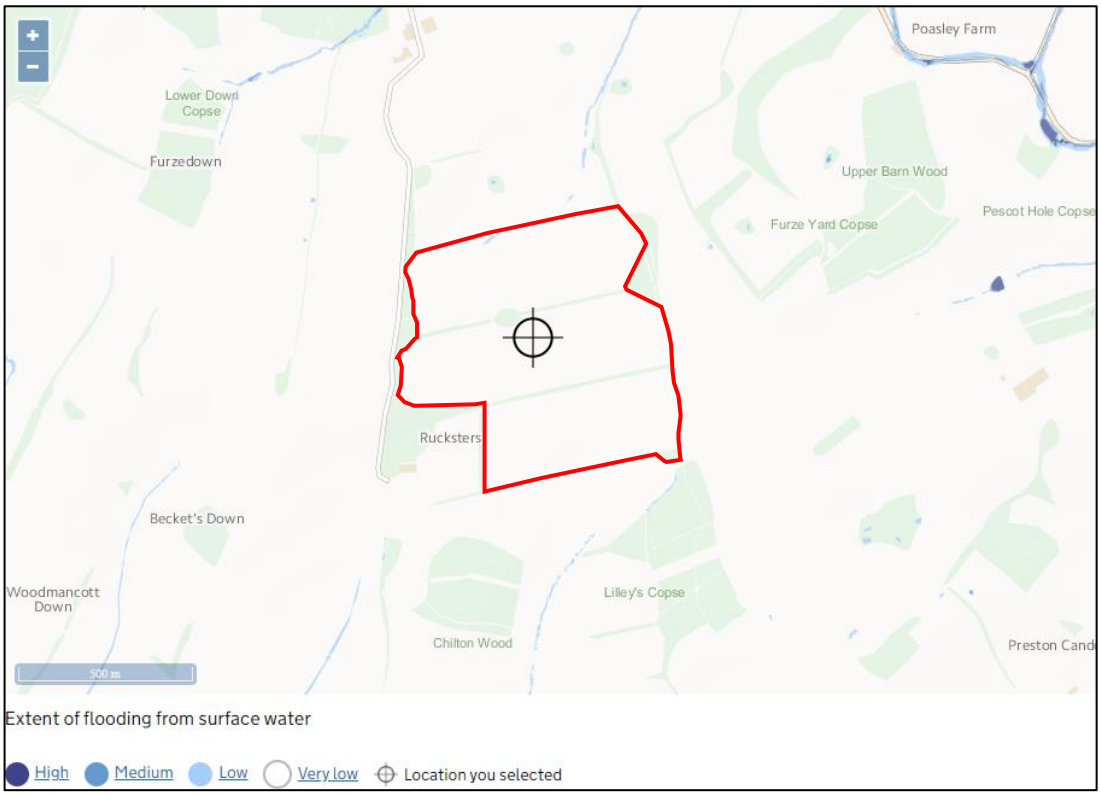


Figure 4.3: Environment Agency 'Flood risk from surface water' map (accessed March 2021) – Main Site

Figure 4.4: Environment Agency 'Flood risk from surface water' map (accessed March 2021) – POC site

4.3.1 Climate change

Surface water flooding is likely to increase as a result of climate change. Increased intensity and frequency of precipitation is likely to lead to reduced infiltration and increased overland flow. Climate change guidance for rainfall intensity has recently been updated by the EA in late February 2016. Revised allowances for climate change have been included in the indicative drainage strategy (refer to Section 7).

4.4 Flooding from groundwater

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

Groundwater levels recorded from the nearby BGS borehole records did not identify groundwater near to the surface. Due to the sporadic nature of groundwater flooding, the design of the development and the low possibility of groundwater emergence at the site, it is unlikely that groundwater flooding would affect the development.

The resultant groundwater flood risk is considered to be **very low**.

4.4.1 Climate change

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

4.5 Flooding from sewers

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes.

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption[10]. One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30-year rainfall event. By definition a 1 in 100-year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

When exceeded, the surcharged pipe work could lead to flooding from backed up manholes and gully connections. This could lead to immediate flooding within highways surrounding the site. As described above, surface water would most likely follow the topography of the site and flow into the on-site field drainage ditches.

Given the rural nature of the site, it is unlikely that sewer flooding will impact on the site.

To ensure that sewer and surface water flooding is not exacerbated; surface water must be considered within the design of the site. This ensures that any additional surface water and overland flows are managed correctly, to minimise flood risk to the site and the surrounding area. The proposed surface water network on the site should be designed to ensure exceedance of the network has been considered.

The resultant sewer flood risk is considered to be **very low**.

4.5.1 Climate change

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but would not impact the site.

[10] WRC, 'Sewers for Adoption' 7th Edition, August 2012

4.6 Other sources of flooding

4.6.1 Reservoirs

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures. The EA reservoir flood map (reproduced as **Figure 4.5** and **Figure 4.6**) shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a worst-case scenario, it is unlikely that any actual flood would be this large. According to the EA Reservoir flood maps the site is not at risk of flooding from reservoirs.

Reservoir flooding is also extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to ensure reservoirs are maintained. The resultant flood risk is considered to be **very low**.

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

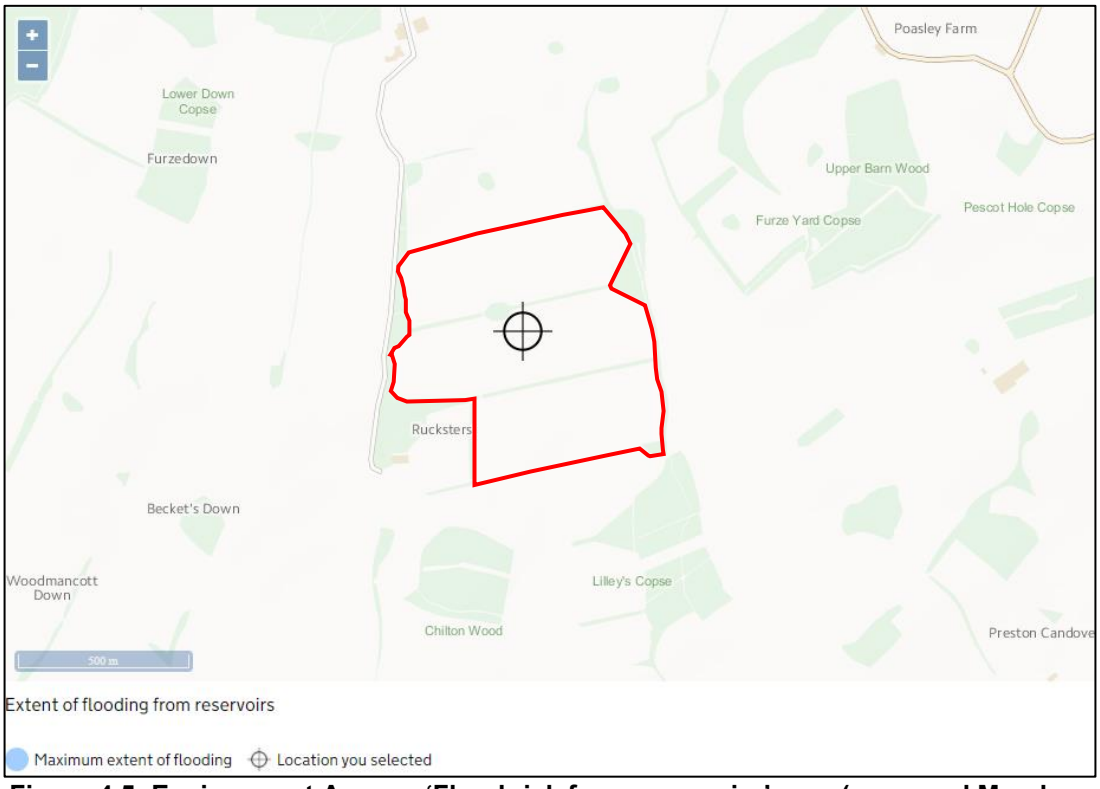


Figure 4.5: Environment Agency 'Flood risk from reservoirs' map (accessed March 2021) – Main Site

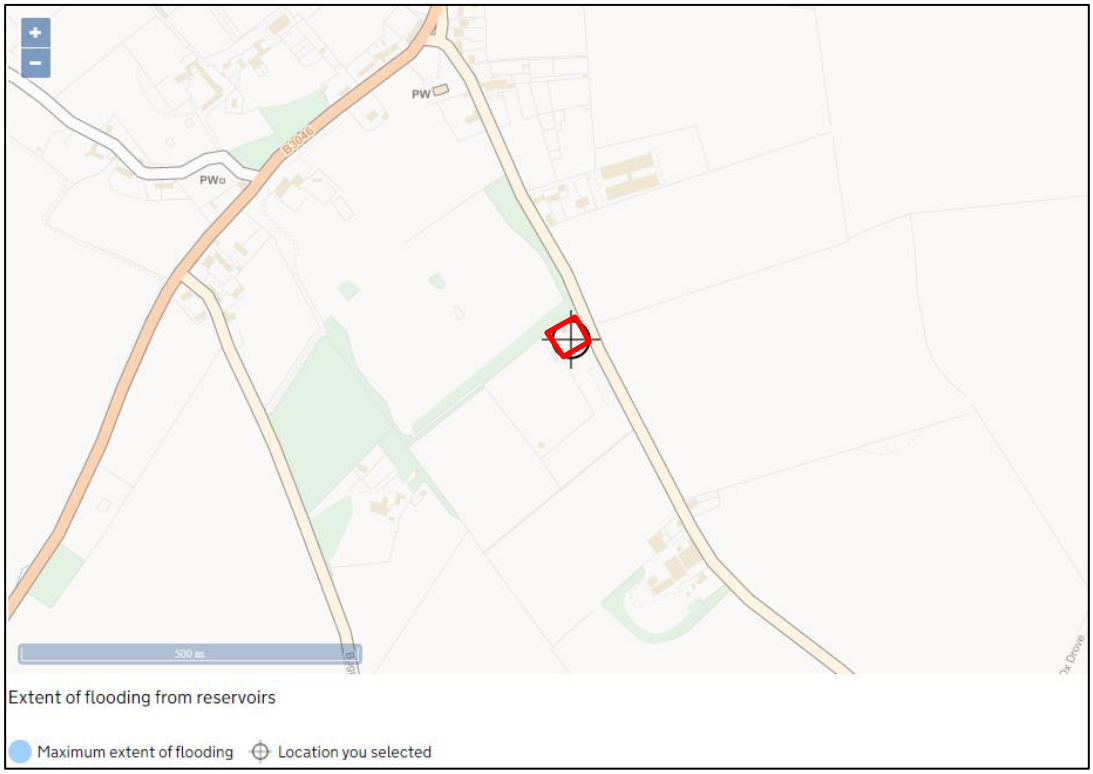


Figure 4.6: Environment Agency 'Flood risk from reservoirs' map (accessed March 2021) – POC Site

4.6.2 Canals

There are no Canal & Rivers Trust owned canals by the within the vicinity of the site. As a result, the risk to the site from this source is considered low.

4.6.3 Blockages of artificial drainage systems

There is a possibility that flooding may result due to culverts and/or sewers being blocked by debris or structural failure. This can cause water to backup and result in localised flooding, as well as placing areas with lower ground levels at risk.

There are no known on-site field boundary drainage ditches across the site, therefore the risk of any blockages is negligible.

4.7 Historic flooding

Examinations of Environment Agency records of historic flooding show that the general area has not previously flooded.

5 FLOOD MITIGATION MEASURES

5.1 Overview

The site lies within Flood Zone 1. To facilitate the development of the site a surface water drainage strategy has been proposed.

5.2 Overland flood flow

No further overland flow control measures are proposed as all surface water runoff up to the 1 in 100 year climate change storm will be stored on site and discharged via infiltration into the ground to replicate the existing situation.

5.3 Finished floor levels

The developable area of the site will be within flood zone 1, as such there is no requirement to raise the floor levels of the infrastructure or the panels to protect against flood risk.

6 PLANNING CONTEXT

6.1 Application of planning policy

Section 14 of the NPPF includes measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the EA Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

6.2 Land use vulnerability

Planning Practice Guidance (PPG) includes a list of appropriate land uses in each flood zone dependent on vulnerability to flooding. In applying the Sequential Test, reference is made to Table 6.1 below, reproduced from Table 3 of PPG.

Table 6.1: Flood risk vulnerability and flood zone 'compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	**Appropriate**	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

With reference to Table 2 of the PPG, the use as a solar farm energy production site is classed as 'Essential Infrastructure'. This classification of development is suitable within Flood Zone 1.

6.3 Sequential Test

The Sequential Test is required to assess flood risk and the PPG recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1).

According to NPPF, if there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (see NPPF Technical Guidance Table 2) can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3.

Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources.

The development proposal includes ‘Essential Infrastructure’ industrial uses to be developed on this site. With reference to Table 6.1 above, as the site is located within Flood Zone 1, the proposed development is appropriate and passes the sequential test.

7 SURFACE WATER DRAINAGE ASSESSMENT

7.1 Scope

The site is located in Flood Zone 1, and is greater than 1ha in size, therefore the EA requires such development to focus on the management of surface water run-off. This section discusses the potential quantitative effects of the development on both the risk of surface water flooding on-site and elsewhere within the catchment, as well as the type of potential SuDS features that could be incorporated as part of the masterplan.

In accordance with the Defra Non-Statutory Technical Standards, the surface water drainage strategy should seek to implement a SuDS hierarchy that aspires to achieve reductions in surface water runoff rates to greenfield rates. Where a reduction to the greenfield rate is not practicable, the proposed surface water drainage strategy should not exceed the existing runoff rate.

In addition, Building Regulations Part H[11] requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option being to a sewer (surface water before combined). Infiltration techniques should therefore be applied wherever they are appropriate.

7.2 Pre-development situation

The existing site area is 46.6Ha and 0% impermeable.

The pro-rata IoH 124 method[12] has been used to estimate the Greenfield surface water runoff for the total site area of the site, shown in Table 7.2. Calculations are contained in **Appendix D**.

Table 7.1: IOH 124 surface water runoff (greenfield) for total site area (46.6Ha)

Return period	Peak flow (l/s)
QBar	23.5
1 in 30 year	53.3
1 in 100 year	75.0

[11] HM Government (2010 with 2013 amendments), 'The Building Regulations 2010: Approved Document H - Drainage and Waste Disposal (2002 Edition incorporating 2010 amendments)'

[12] Institute of Hydrology (IoH), 'Flood Estimation for small catchments - Report 124', 1994

7.3 Off-site discharge options and limits

7.3.1 Infiltration

Infiltration should be considered as the primary option to discharge surface water from the developed site. The effectiveness of infiltration is completely dependent on the physical conditions at the site. Potential obstacles include:

- Local variations in permeability preventing infiltration – It is understood from the BGS geological mapping that the site is underlain with superficial clay, sand and silts, therefore testing maybe required to ascertain if this is a feasible option;
- Shallow groundwater table - For infiltration drainage devices, Building Regulation approved document H2 states that these "should not be built in ground where the water table reaches the bottom of the device at any time of the year"; and,
- Source Protection Zones - The south-east of the site is located within a Groundwater Source Protection Zone 3.

Based on the underlying geology of the site and the limited hardstanding areas generating additional run off, infiltration techniques may be used in the surface water drainage design.

7.3.2 Discharge to watercourse

Discharging surface water directly to a local watercourse is not considered feasible for the site, as there are no nearby mapped watercourses.

7.3.3 Discharge to surface water sewer

There is not thought to be any surface water sewers within the site area, hence discharge to sewer is not a feasible option.

7.4 Post-development situation

According to the principles of the BRE planning guidance for the development of large-scale ground mounted solar PV systems, in general solar panels do not increase the impermeable area of a site and it is generally considered that they do not contribute to an increase in surface water runoff from the site.

The solar panels will not increase the impermeable area across the site; therefore, no formal drainage is required. As such a pragmatic approach has been developed to promote infiltration and provide storage areas across the site to reduce the volume of water runoff from the site. This will involve the design of soakaways for the inverter stations and private switch rooms, and backfilled trenches / swale features for the solar panels. These features will intercept and attenuate runoff, promoting infiltration across the site.

7.4.1 Solar arrays

7.4.1.1 Design

It is anticipated that any precipitation falling on each solar panel will runoff the panels and flow towards / infiltrate in the rain shadow of the down-slope modules. The rows of panels on the site are generally aligned from parallel to a 45^{o} angle to the contours of the site. As such rainwater falling of the trailing edge of the panels will generally flow away from

the base of the panels between a 90º and 45º angle towards the rain shadow of the down-slope panels. This feature will enable the use of the rain shadow area of the panels to maintain the infiltration potential of the site.

In some instances, runoff from solar panels could result in the kinetic compaction of soils at the base of the panels and the intensification of runoff into rivulets running along the trailing edge of the rows of panels. This could conceivably lead to a slight increase in the amount of runoff when compared to the pre-development situation resulting from a decrease in infiltration potential.

The specifications of the solar array supports are to be designed to be widely spaced and are driven vertically into the ground with no additional foundations. The arrays are in rows with spaces of several metres in between the leading edge of one row and the trailing edge of the row behind.

The panels are typically mounted in triple horizontal rows and are separated by a horizontal 'rainwater' gap. This gap allows rainwater to drain freely to the ground between the panels helping to replicate the Greenfield runoff conditions.

Whilst it is considered that solar arrays will not result in a material increase in surface water runoff flow rates and volumes, it is proposed to use a form of SuDS (swales / infiltration trenches) to intercept extreme flows which may already exist flowing off-site. As such it is emphasised that the swales / infiltration trenches do not form part of a formal drainage scheme for the development but are proposed as a form of 'betterment' on existing rates.

7.4.1.2 Vegetation and soil structure

Sustainable management of the post development situation in terms of vegetation planting and soil type can be used as a means of managing surface water runoff from the solar panels. As such to ensure that there is no increase in surface water runoff managed sustainable vegetation (with a good soil structure e.g. chisel ploughed soils) will be allowed to grow beneath the solar panels, which will avoid kinetic compaction and ensure that any potential instances of rivulet formation are minimised and surface water runoff flows over the ground in a natural way. Vegetation planting and soil management should be site wide to encompass all solar panel rows.

7.4.2 Inverter Stations, DNO substation and Private Switch

It is intended that surface water runoff from the inverter stations, DNO and switch room will be discharged to the ground after passing through a drainage trench to closely mimic the existing situation. The design rainfall event for this assessment has been taken as the 6 hour, 1 in 100-year event with the intention of retaining any additional surface water runoff generated as a result of the development on the site in the drainage trench. The possible methods of discharging surface water from the site will be via the existing drainage infrastructure on-site or due to the small volumes of runoff, by using natural infiltration / evaporation.

Table 7.2 details the specifications of the indicative drainage trenches that could be used to serve the inverter stations, private switch and DNO substation. The length of the drainage trench has been determined using the perimeters of the inverter stations, DNO substation and private switch.

Table 7.2: Approximate Drainage Trench Sizing and Volumes

Description	6hr 1 in 100-year Rainfall (mm)	Impermeable Development Area (m^2)	1 in 100 yr Surface Water Volume Required (m^3)	1 in 100yr Volume Required with 20% Climate Change (m^3)	Trench Sizing				Volume Created (m^3)*
					Side Slope	Width (m)	Depth (m)	Length (m)	
Private switch	63.76	20	1.28	1.54	Vertical	0.5	0.6	20	1.80
Inverter station (each)	63.76	20	1.28	1.54	Vertical	0.5	0.6	20	1.80
DNO substation	63.76	30	1.91	2.29	Vertical	0.5	0.6	27	2.43

*Assuming a 0.3 void ratio for backfilled trench

The rainfall data used in the calculations has been gathered from the Centre of Ecology and Hydrology's Flood Estimation Handbook rainfall database (FEH CD ROM Version 3). In accordance with National Planning Policy Framework, climate change has been taken into consideration for the lifetime of the development; as such an increase in rainfall of 20% has been included in the storage requirements.

The attenuation volume (m^3) calculated per metre for the hardstanding, has been calculated using a void ratio of 0.3 of the total volume of aggregate in the trench. The trenches are to be a back filled with suitably sized and sourced aggregate, to allow appropriate attenuation.

If natural infiltration on site is not adequate to effectively discharge surface water runoff from the inverter stations, DNO substation and private switch, the trenches would be utilised as on-site attenuation. These would be designed to store excess runoff before naturally discharging via overland flow.

7.4.3 Access track surface water drainage

Where required, access tracks are kept to a minimum, and be a temporary measure. As such, 'floating roads' could be used on site, typically these will require a wide strip of geotextile laid on the ground covered by a nominal layer of stone to form the track. As such the access tracks will maintain a permeable nature and not increase the surface water runoff from the development. Any flows in excess of the infiltration rates will discharge to the surrounding ground and will not impact on land outside of the site. For solar panel maintenance access could be gained by way of using 4x4 vehicle, quadbike or agricultural vehicles to minimise impacts on the ground.

7.4.4 Maintenance

Maintenance of any drainage network is essential to ensure optimal performance of the drainage elements. As such maintenance requirements of the drainage system will include, but not be limited to the inspection and cleaning of backfilled trenches / swales to ensure that the capacity and infiltration rates are maintained.

The drainage systems are likely to remain in private ownership and therefore the site operator will be responsible for the maintenance of the drainage features on site.

8 CONCLUSIONS AND RECOMMENDATIONS

This FRA complies with the NPPF and Planning Practice Guidance and demonstrates that flood risk from all sources has been considered in the proposed development. It is also consistent with the Local Planning Authority requirements with regard to flood risk.

The site lies in an area designated by the EA as Flood Zone 1, outlined to have a chance of flooding of 1 in 1000 or less (0.1%) in any year.

NPPF sets out a Sequential Test, which states that preference should be given to development located within Flood Zone 1. This flood risk assessment demonstrates that the requirements of the Sequential Test have been met, with the site area located within Flood Zone 1 and 'Essential Infrastructure' classification of the development.

This flood risk assessment has considered multiple sources of flooding and concluded the following:

Table 8.1: Flood risk summary

Source	Level of risk	Mitigation
Fluvial	Very Low	The main PV and POC sites are both located in an area of Flood Zone 1 with no watercourses on or adjacent to the site that could pose a risk
Tidal	Very Low	The main PV and POC sites are both located in an area of Flood Zone 1 with no tidal influences near the site.
Surface water	Very Low	The main PV and POC sites are generally very low risk from this source with one minor flow path located on the north of the main PV site. Given the type of development proposed, this source of flooding is not thought to cause any determinantal impact to the operation of the site.
Groundwater	Very Low	BGS records do not indicate groundwater flood risk to be an issue at the site.
Sewers	Very Low	There are no known sewers on-site and therefore flood risk from this source is considered very low.
Reservoirs	Very Low	The site in not in an area at potential risk from reservoir flooding
Artificial sources	Low	There are no on site water features that could pose a risk of flooding from this source.

The site is currently a greenfield site and is existing agricultural land. The proposed development will only alter the impermeable area on site by a negligible amount, resulting in a negligible increase in surface water runoff from the inverter stations, DNO substation

and private switch. The solar panels will not increase the impermeable area on-site, and therefore will not increase the volume of surface water runoff.

There is the potential for the inclusion of small backfilled trenches to provide a betterment for off-site discharge to be placed near the perimeters of the inverter stations, DNO substation and private switch. Using this measure as outlined in Section 7.4, there is potential to provide on-site storage, thereby reducing the amount of greenfield runoff that exits the site, and as such assisting in reduced flood risks downstream.

NPPF sets out a Sequential Test, which states that preference should be given to development located within Flood Zone 1. This flood risk assessment demonstrates that the requirements of the Sequential Test have been met, with the location of the site being within Flood Zone 1 and 'Essential Infrastructure' classification of the development.

Overall, taking into account the above points, the development of the site should not be precluded on flood risk grounds.

APPENDIX A
RSK GROUP SERVICE CONSTRAINTS

1. This report and the drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for RSK ADAS (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable civil engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

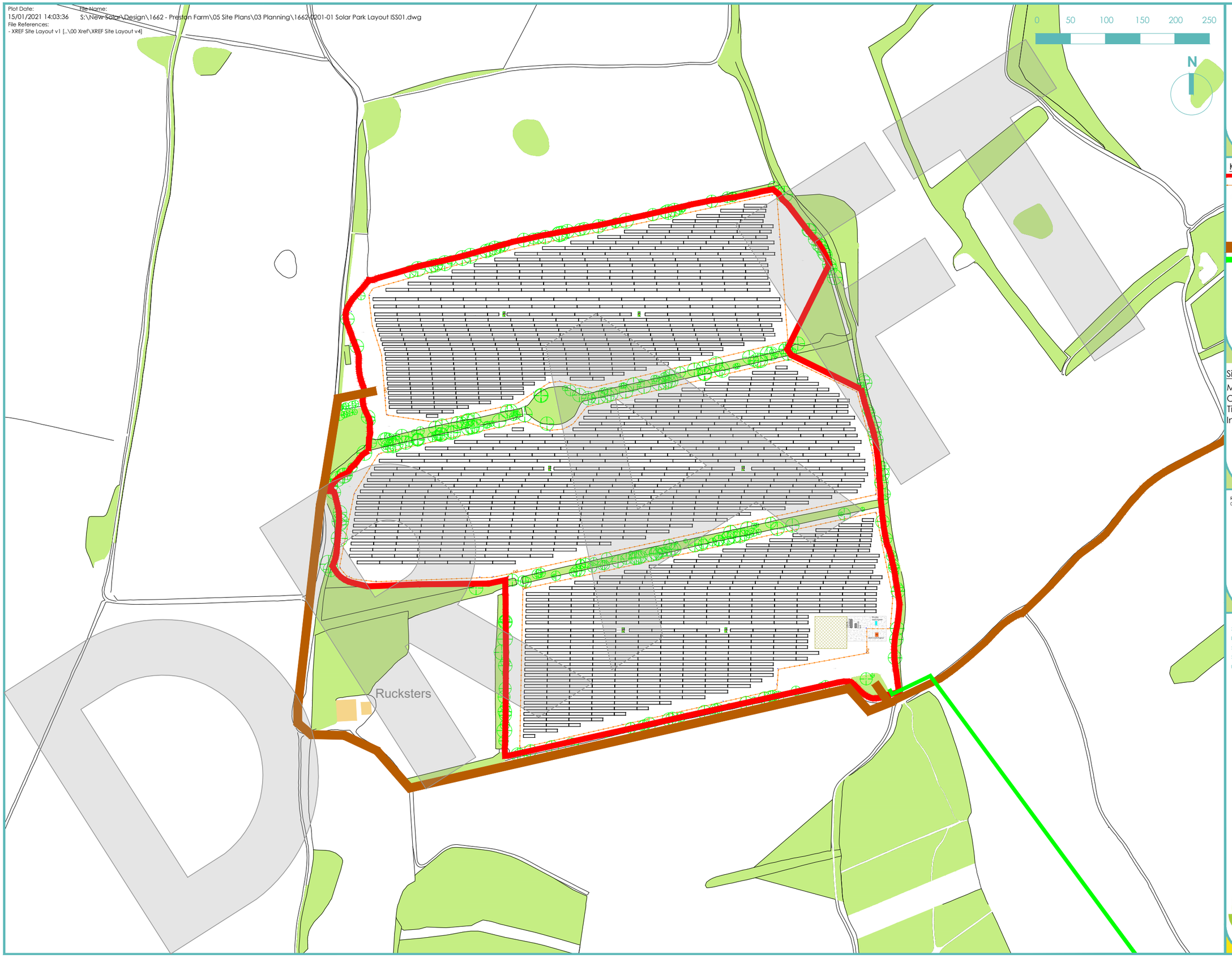
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the appropriate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B
DEVELOPMENT LAYOUT

Plot Date:
15/01/2021 14:03:36

File Name:
S:\New Solar\Design\1662 - Preston Farm\05 Site Plans\03 Planning\1662-0201-01 Solar Park Layout ISS01.dwg

File References:
- XREF Site Layout v1 [..\00 Xref\XREF Site Layout v4]



Notes: Unless otherwise stated, this drawing is for information only. Do not scale. Use figured dimensions only. Check all dimensions on site and advise of any discrepancies before commencing work on site.

Digital Transmissions: This data is supplied only as a means to aid you in the production of your work. the data should always be checked against the hard copy of the drawing. Some of the data may have been produced by importing data from external sources, discrepancies may have occurred during this procedure. BSR cannot accept responsibility for any discrepancies within the CAD data file. No third party shall issue BSR data/drawings without the written approval of BSR. BSR check all data for viruses but cannot accept responsibility for any loss incurred by any third party as a result of installing data.

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Key:

- Site Boundary
- Fence
- Solar Arrays
- Construction Compound
- Substation Area
- Inverter
- Access Track
- Cable Route
- CCTV
- Private Switch
- DNO

Site Information:

Modules:	Longi 540W
Orientation	2 in Portrait
Tilt Angle	23°
Inverters:	6

Rev:	Revision History:	Date:	By:
01	Initial Issue	10/12/20	JA

35 and 35a The Maltings
Lower Charlton Trading Estate,
Shepton Mallet,
Somerset,BA4 5QE
United Kingdom

E:info@britishrenewables.com
T:01458 224900
W:www.britishrenewables.com

Project:
Preston Solar Farm

Location:
Preston Farm
Preston Candover
Bassingstoke, Hampshire
RG25 2DS

Title:
Solar Park Layout

Scale: 1:5000 @A3

Issue Notes:
Initial Issue

Drawn By: JA	Issue Date: 10/12/20
Checked By: MB	Checked Date: 10/12/20
Approved By: Initials	Approved Date: Date

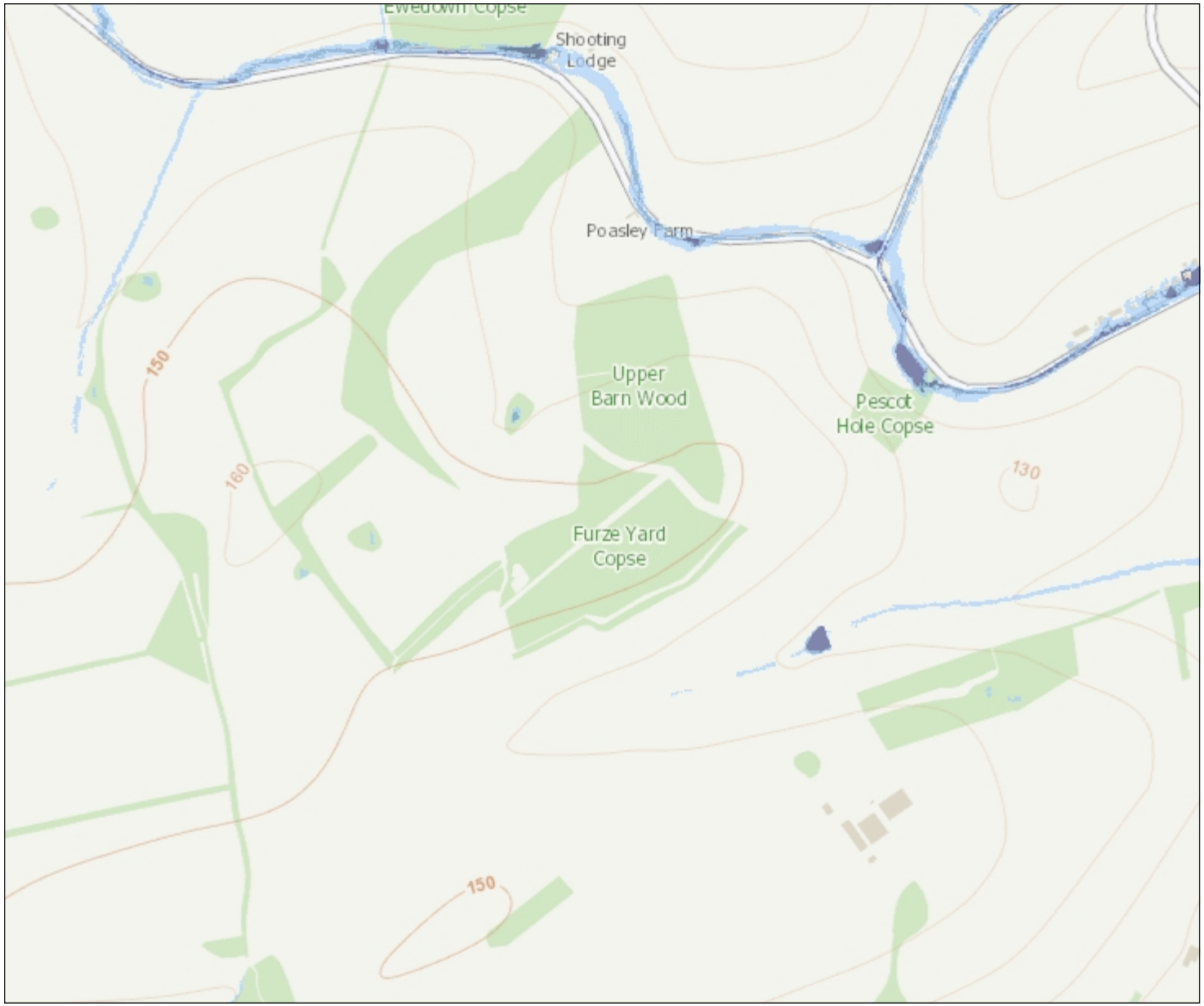
Drawing Number:
1662-0201-01

Drawing Status: Issued For Approval	Issue: 01

BSR Energy

APPENDIX C
ENVIRONMENT AGENCY CORRESPONDENCE

Risk of flooding from Surface Water - Centred on Preston Farm, Candovers, Hampshire - Created 18 December 2020



Environment Agency

1: 10,000

0 Metres 250

N W E S

Likelihood of flooding from Surface Water

- High (>=3.3%)
- Medium (3.3% - 1%)
- Low (1% - 01%)
- Very Low
- Flood Extent 1 in 30
- Flood Extent 1 in 100
- Flood Extent 1 in 1000

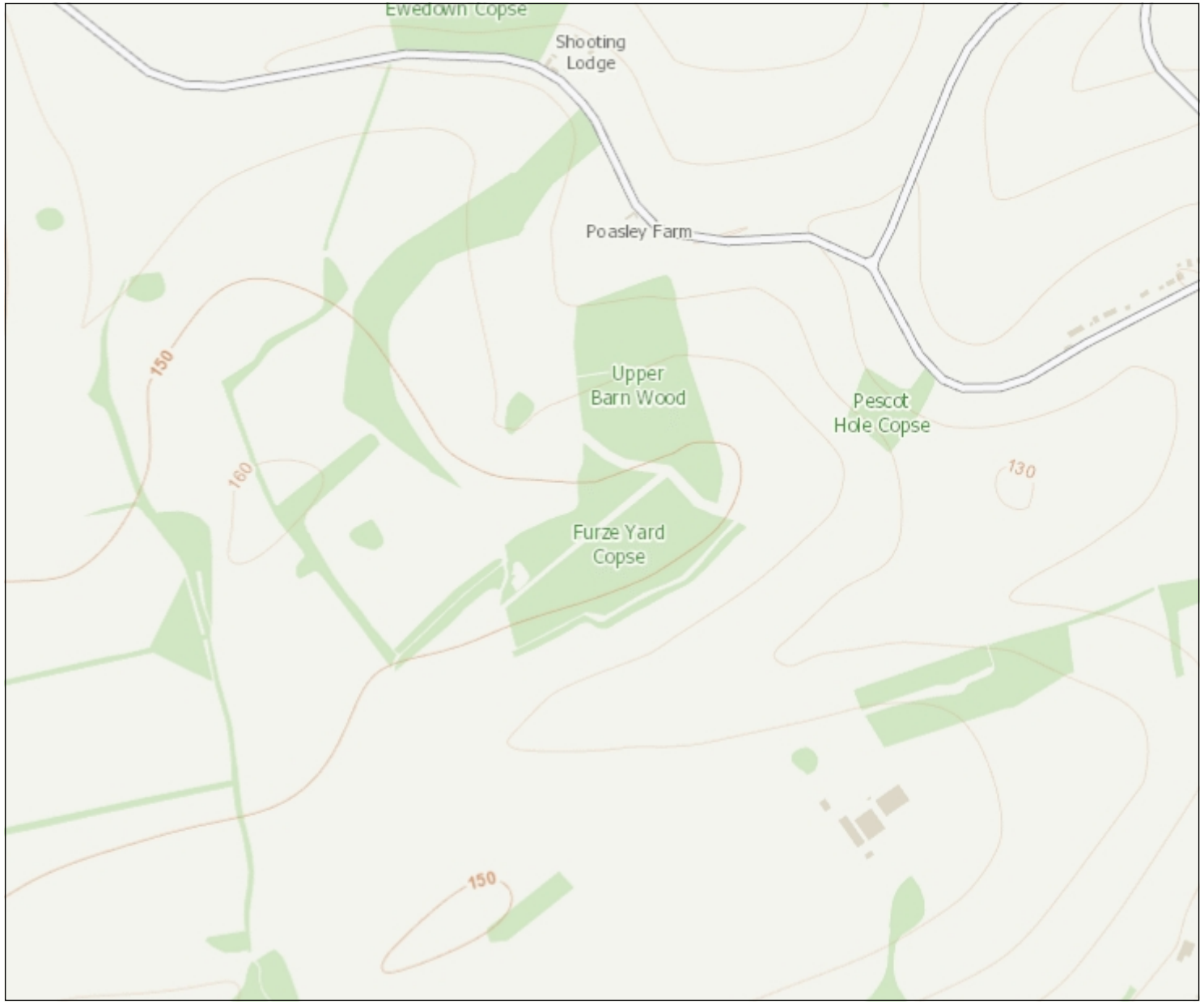
Likelihood of flooding from Surface Water

High:	Greater than or equal to 3.3% (1 in 30) chance in any given year
Medium:	Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
Low:	Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
Very Low:	Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). E-mail: enquires@environment-agency.gov.uk

Flood Map for Planning (Rivers and Sea) - Centred on Preston Farm, Candovers, Hampshire - Created 18 December 2020



Environment Agency

1: 10,000

0 Metres 250

N W E S

Flood Map for Planning (Rivers & Sea)

- Defences
- Flood Storage Areas
- Areas benefiting from flood defences
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occuring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Colin Whittingham

From:	Partnership and Strategic Overview team, HIOW <psohiow@environment-agency.gov.uk>
Sent:	18 December 2020 09:54
To:	Kathryn Olive
Cc:	SSD Enquiries
Subject:	Flood Risk Information (Product 4) for site at Preston Farm, Candovers, Hampshire - Our ref: SSD/195234
Attachments:	Flood Map for Planning (Rivers and Sea).pdf; Risk of Flooding from Surface Water.pdf; Open Government Licence.pdf; Use of EA Information for FRAs.pdf

Dear Kathryn,

Enquiry regarding Product 4 for site at Preston Farm, Candovers, Hampshire

Thank you for your enquiry which was received on 18 November 2020.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

We can confirm that the above property/site is located in Flood Zone 1 - an area where the chance of flooding from both rivers and the sea has been assessed as less than 0.1% in any year (1 chance in 1,000 in any year).

The Environment Agency has no record of flooding to this property/area, please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flooding Authority, Hampshire County Council or the Local Authority, Basingstoke and Deane District Council for a more comprehensive flood history check.

The Environment Agency is not aware of any flood defences in this area.

Flood Levels – This site is located within Flood Zone 1 as such no flood levels are available for this site.

FRA advisory text

Name	Product 4
Description	Detailed Flood Risk Assessment Map for site at Preston Farm, Candovers, Hampshire
Licence	Open Government Licence
Information Warnings	The majority of our models will not have the new climate change allowances. +20% is not suitable for the majority of planning purposes and the new allowances to use should be checked here: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
Information Warning - OS background mapping	*The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.*
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2017 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning (Flood Zone 2, Flood Zone 3 ,Flood Storage Areas, Flood Defences, Areas Benefiting from Defences)
- Risk of Flooding from Rivers and Sea
- Historic Flood Map
- Current Flood Warnings

Does Your Proposal Have Environmental Issues or Opportunities? Speak To Us Early!

If you are planning a new project or development, we want to work with you to make the process as smooth as possible. Early engagement can improve subsequent planning applications to you and your clients' benefit and deliver environmental outcomes. For a cost recovery fee of £100 per hour plus VAT we will provide you with a project manager who will coordinate all meetings and reviews in order to give you detailed specialist advice with guaranteed delivery dates. More information can be found on our website here.

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Yours sincerely,

Naomi Groome
Partnership and Strategic Overview team, Hampshire and Isle of Wight
Environment Agency

Direct dial 020 8474 7504
Email psohiow@environment-agency.gov.uk

APPENDIX D
GREENFIELD RUNOFF CALCULATIONS

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	46.600	Urban	0.000
SAAR (mm)	845	Region Number	Region 7

Results l/s

QBAR Rural	23.5
QBAR Urban	23.5
Q100 years	75.0
Q1 year	20.0
Q30 years	53.3
Q100 years	75.0